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TRANSPARENT CATHODE AS A NEW CHERENKOV OSCILLATOR

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The transparent cathode is a cathode in which separate longitudinal emitters are periodically placed about a fixed radius from the center [1]. Owing to the longitudinal current along each emitter there is a periodic azimuthal magnetic field in which electrons drift in an applied radial electric and longitudinal DC magnetic field. Thus, this cathode in a smooth-walled tube operates as an ubitron or free electron laser. In this device, with the transparent cathode placed in the center of a smooth-walled tube, slow eigenmodes exist. Therefore, synchronous interaction of electrons with slow eigenmodes, as in an M-type Cherenkov backward wave oscillator (BWO), is possible. In contrast with BWOs where the anode is the SWS and is where the electromagnetic (EM) fields are concentrated, in this device the EM fields are concentrated near the transparent cathode where electrons are emitted and drift around the cathode in crossed applied electrical and magnetic fields. Using computer simulations with the particle-in-cell (PIC) code MAGIC we demonstrate this new oscillator with high efficiency microwave generation. In this oscillator we use a transparent cathode comprising 8 emitters with length 2.5 cm, maximal radius 9 mm, minimal radius 6 mm, each with azimuthal width 30° and distance between emitters 15°, which are placed in a smooth-walled tube with radius 2.5 cm and length 9 cm. Preliminary results suggest that when an axial magnetic field of 7.5 kOe (over the cathode) and applied voltage 600 kV are applied, the output radiated power is 1.66 GW with 70% efficiency with outpu radiation frequency 5 GHz. Prospects for scaling this device to high frequency will be discussed.

1. M.I. Fuks and E. Schamiloglu, "Rapid Start of Oscillations in a Magnetron with a Transparent Cathode," Phys. Rev. Lett., vol. 95, 205101-1-4 (2005).

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